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RECORDING AND REPRODUCING APPARATUS
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SPECIFICATION /1*

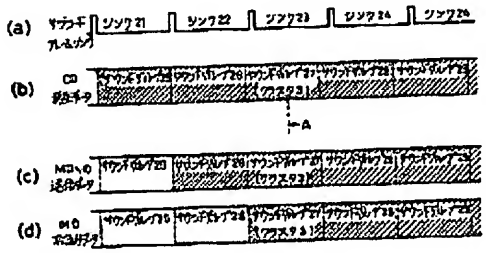
(54) Title:

RECORDING AND REPRODUCING APPRATUS

(57) Abstract:

[CONSTITUTION] A cluster is the smallest recording unit made up from multiple compression units (sound groups). If an error should occur while recording sound group 27 of cluster 3, for example, dubbing is temporarily halted. CD detects synchronizing signal of each sub-code frame (access unit) and, for example, resumes reproduction at sub-code frame two units prior to the error generating location, and creates a new compressed data. The MD recording & reproduction system verifies the new compressed data against the compressed data of cluster 3 already stored in the buffer memory. And the buffer memory is re-written starting with sound group 27 where the error had occurred. Thereafter, data recording is resumed from the beginning of the cluster 3.

[EFFECT] To perform dubbing without data break even if errors should occur during dubbing, regardless of data transfer speed and the difference in recording formats of recording media.



* Numbers in the margin indicate pagination in the foreign text.

[Claims] /2

[CLAIM 1] A recording and reproduction apparatus comprised from a reproduction system which reads out digital data from the first recording media with digital data stored in the accessing order, and also from a recording system that compresses and records above digital data to the second recording media, and which has:

A memory device that temporarily stores the compressed data, which was compressed by above recording system, by units of compression;

A recording device that reads out compressed data intermittently from above memory device, where the smallest recording unit is made up from multiple compressed units, and sequentially records minimum recording units in the above second recording media;

A halt command device that detects errors from at least either of reproduction errors of above first recording media or recording errors of above second recording media, and temporarily stops operation of recording system and reproduction system accordingly;

A reproduction control device that detects the access unit where an error has occurred during reproduction, and resumes reproduction by reproduction system starting from several access units before the access unit where the error had originated;

A verification device that identifies and reads out from the memory device the compressed data corresponding to the access unit which resumed reproduction, and verifies this data against the new compressed data created after the resumption of reproduction, and identifies the starting location of the compression unit of the new compressed data;

A memory control device that, based on the result of above verification device detection, re-writes new compressed data starting from the beginning of the compression unit where the error had occurred; and
A recording control device that reads compressed data from above memory device starting with the beginning of the smallest recording unit where the error had occurred, and that resumes recording on above second recording media of the recording system.

[Detailed Description of the Invention]

[0001] [INDUSTRIAL APPLICATION]

This invention relates to recording and reproduction device which first takes and compresses audio data created from digital audio signals of continuous information, which stores the compressed data temporarily in a buffer memory, which reads audio data intermittently from the buffer memory at a faster read transmission speed than the write transmission speed for storing, and which records the data to the recording device in high density. Especially, this invention is related to recording and reproduction device that performs dubbing of audio information from compact disk reproduction system to mini disk recording system.

[0002] [DESCRIPTION OF THE PRIOR ART]

In the last 10 years, recording and reproduction system of audio signals have rapidly shifted from analog format to digital. As consumer recording media, compact disks (CD, hereafter) which are reproduction-only optical disks of digital audio signals, digital compact cassettes which are recording & reproduction magnetic tapes, and mini-disks (MD, hereafter) which are magnet-optical disks that can

record/reproduce/delete have been developed. The above mentioned MDs have been miniaturized into smaller sizes than CDs, so that the diameters of MDs are about 1/2 of that of CDs. Further, data of digital audio signals recorded on the MD are, in order to secure equivalent data storage capacity as the CD, compressed into about 1/5 size by an audio high efficiency coding method called ATRAC (Adaptive Transform Acoustic Coding).

[0003] Further, above mentioned digital type drive systems for recording media are also required to be equipped with two types of recording media and be able to dub, namely transfer, audio information from one recording media to another. For example, JP H4-332960 and JP H4-258834 mentioned recording and reproducing devices that can perform dubbing of compressed digital audio signal typically recorded on MDs.

[0004] Further, JP H3-119559 describes a method on how to process when reproduction errors occur on the CD side while dubbing audio information from CDs to analog compact cassettes.

[0005] [PROBLEMS TO BE SOLVED BY THE INVENTION]

However, JP H4-332960 and JP H4-258834 did not reveal any retry methods, in case of reproduction or recording errors, to resolve such errors without interrupting dubbed audio information.

[0006] Similarly, although JP H3-119559 discussed ways to go back to the error location of the recording media in order to resume dubbing, it is very difficult, strictly speaking, to perform continuous recording at the error location since the recording side uses analog system which records continuous analog audio signals.

[0007] We must also consider situations where digital audio signals are transferred between two recording media of different recording formats as, for example, dubbing audio information from CDs to MDs. In these cases, when recording or reproduction errors should occur, there are as of yet no known retry technology enabling resumption of dubbing starting from the error location without causing any interruptions or duplications of audio information.

[0008] [MEANS FOR SOLVING THE PROBLEM]

In order to resolve the above mentioned issue, the recording and reproduction device of this invention, equipped with a reproduction system which reads digital data from first recording media (for example, CD) where digital data is recorded in the sequence of access units, and equipped with a recording system which compresses and records above mentioned digital data onto second recording media (for example, MD), is characterized by the following devices: (1) A memory device that temporarily stores the compressed data, which was compressed by above recording system, by units of compression (for example, shock-proof memory); (2) A recording device that reads out compressed data /3 intermittently from above memory device, where the smallest recording unit is made up from multiple compressed units, and sequentially records minimum recording units in the above second recording media (for example, system-control microcomputer, memory controller, encoder/decoder signal processing circuit, head activator circuit, recording head, and optical pickup); (3) A halt command device that detects errors from at least either of reproduction errors of above first recording media or recording errors

of above second recording media, and temporarily stops operation of recording system and reproduction system accordingly (for example, system-control microcomputer); (4) A reproduction control device that detects the access unit where an error has occurred during reproduction, and resumes reproduction by reproduction system starting from several access units before the access unit where the error had originated (for example, system-control microcomputer); (5) A verification device that identifies and reads out from the memory device the compressed data corresponding to the access unit which resumed reproduction, and verifies that data against the new compressed data created after the resumption of reproduction, and identifies the starting location of the compression unit of the new compressed data (for example, system-control microcomputer); (6) A memory control device that, based on the result of above verification device detection, re-writes new compressed data starting from the beginning of the compression unit where the error had occurred (for example, shock proof memory controller); and (7) A recording control device that reads compressed data from above memory device starting with the beginning of the smallest recording unit where the error had occurred, and that resumes recording on above second recording media of the recording system (for example, system-control microcomputer).

[0009] [FUNCTION]

Under the above mentioned configuration, digital data which was read, by each access unit, from the first recording media are compressed by the recording system and then stored in the memory device by each compression unit. However, the data length of access unit and data length

of compression unit need not match each other. Since multiple compression units are recorded in the second recording media as the minimum recording unit, as soon as compressed data sufficient for a minimum recording unit are stored on the memory device, they are read out starting with the beginning of the minimum recording unit and stored in the second recording device.

[0010] Therefore, even if errors should occur during recording a minimum recording unit, compressed data of such minimum recording unit being recorded are stored in the memory device by compression units. Thus, after errors happen, by resuming the reproduction on the first recording media and by writing newly processed compressed data over the same compressed data stored on the memory device, the dubbing from the first recording media, via memory device, to the second recording media can be continued despite the errors.

[0011] For this to be possible, verification is needed which verifies that the newly compressed data after resumption of reproduction and the compressed data stored in memory device do match each other. This verification should go through the following steps:

① Identify the access unit which was being reproduced when the error occurred on the said first recording media;

② Resume reproduction starting with several access units prior to the access unit which generated the error;

③ Identify and read out from the memory device the compressed data corresponding to the access unit where the reproduction was resumed;

④ Verify the above compressed data read from the memory device against the new compressed data created after the resumption of reproduction;

⑤ Identify the staring position of compression unit of the new compressed data and confirm the memory position of the memory device; and

⑥ Overwrite the new compressed data on the memory device starting with the beginning of the compression unit where the error had occurred. By taking these steps, first overwrite to the memory device all compressed data of the minimum recording unit where the error had occurred, then read out from the memory device the compressed data starting from the beginning of the minimum recording unit and resume recording to the second recording media. In this manner, the dubbing can be continued despite the interruption from the error.

[0012] above, said ① and ② controls are done by reproduction control device, said ③ and ④ controls are done by verification device, and said ⑤ and ⑥ controls are done by memory control device.

[0013] thus, this invention provides relatively easy control method, even when the storage formats of the first recording media and of the second recording media are different, to resolve errors which occur while dubbing digital data from the first recording media onto the second recording media.

[0014] [EXAMPLE OF APPLICATION]

In the following, an example of application of this invention is described below using Figs. 1 through 5. In this example, however, as one example of recording & reproduction device under this invention, a recording & reproduction device is described which consists of an MD recording & reproduction device that records and reproduces audio information against MDs and of a recording & reproduction device that allows dubbing of audio information from CD to MD.

[0015] As is shown in Fig. 5, the said MD recording & reproduction system is made up from a disk 31 for a MD (the second recording media stated in the claim section), an optical pickup 32, a RF amplifier 33, an encoder/decoder signal processing circuit 34, a shockproof memory controller ('memory controller' hereafter) 5, a shockproof memory (buffer memory) 6, a voice expanding/compressing circuit 7, a D/A and A/D converter 8, a system-control microcomputer 9, a servo circuit 10, driver circuit 11, a spindle motor 12, feed motor 13, a power ON/OFF circuit 14, a /4 head activator circuit 15, a recording head 16, a voice output terminal 17, a voice input terminal 18, a switching unit 19, and a key recognition circuit 42.

[0016] On the other hand, the said CD reproduction system is made up from a disk 41 for a CD (the first recording media stated in the claim section) and a CD reproduction device 20. The CD reproduction device 20, controlled by the system-control microcomputer 9, performs normal reproduction of disk 41, and the CD reproduction device 20 is also controlled normally to read audio information from disk 41 at a higher

speed than reproduction when the audio information from disk 41 is being dubbed to disk 31.

[0017] During the reproduction by disk 31, the disk 31 is rotated driven by the spindle motor 12 which in turn is driven by the driver circuit 11. The optical pickup 32, for reading audio data recorded on disk 31, is sent in the direction of the radius of disk 31 by the feed motor 13 driven by driver circuit 11. Additionally, the object lens of the optical pickup 32 is moved in the focusing direction and tracking direction by an actuator (not shown) driven by the driver circuit 11.

[0018] The audio data, read by optical pickup 32, is amplified by RF amplifier 33 and sent to encoder/decoder signal processing circuit 34. Further, from audio data being read, RF amplifier 33 generates servo control signals from focus error signals and tracking error signals, and outputs them to servo circuit 10.

[0019] The servo circuit, based on servo control signals from said RE amplifier 33 and control signal from system-control microcomputer 9, applies a servo to control the said driver circuit 11 on focusing and tracking of optical pickup 32 and rotational speed of disk 31. Further, the driver circuit 11 drives optical pickup 32, spindle motor 12 and feed motor 13 according to the control signal from the said servo circuit 10.

[0020] The said encoder/decoder signal processing circuit 34 demodulates audio data that were amplified by RF amplifier 33, processes the signal (for example, corrects errors) and then sends them to memory controller 5. The above memory controller 5 takes audio data sent from above encoder/decoder signal processing circuit 34 and writes the data

to the shockproof memory 6, the memory device mentioned in the claim section. The shockproof memory 6 is equipped, in addition to area for storing audio data, with an area for storing TOC information supplementary to audio data. As soon as a device is inserted into disk 31, TOC information is read from disk 31 and is stored in the specified area of shockproof memory 6 via the same route as the audio data. Further, memory controller 5, in response to requests from system-control microcomputer 9, reads necessary TOC information from shockproof memory 6 and sends that to system-control microcomputer 9.

[0021] The system-control microcomputer 9 is consisted from memory device, halt command device, retry control device and memory system control device, all of which were mentioned in the claim section. This system-control microcomputer 9 controls the system based on TOC information and also reads necessary data from disk 31. The memory controller 5 reads audio data stored temporarily in above shockproof memory 6 sequentially and sends the data to voice expansion/compression circuit 7. The voice expansion circuit of the voice expansion/compression circuit 7 decompresses the audio data by expanding it according to specified format, and sends it to D/A and A/D converter 8. The D/A converter of the D/A and A/D converter 8 converts the received digital signal into analog signal and creates an audio signal. This audio signal is output from the output terminal 17.

[0022] On the other hand, when audio information is stored in the disk 31, that audio information could be input from analog source or could be input, as mentioned above, from CD reproduction device 20. The switching

between these two input systems is done by the switching unit 19 controlled by system-control microcomputer.

[0023] In case audio information is input from analog source, such analog audio signal is input into A/D converter of the D/A and A/D converter 8 through voice input terminal 18 and converted into audio data. However, the speed at which audio data is transferred from A/D converter to voice expansion/compression circuit 7 is faster than the speed at which digital audio signal is transferred from CD reproduction device 20 to voice expansion/compression circuit 7. This is because, as already explained, when audio information from disk 41 is dubbed to disk 31, the read speed of the disk 41 is higher than in normal reproduction.

[0024] The voice compression circuit of the voice expansion/compression circuit 7 compresses the audio data, input through switching unit 19, into 1/5 the size by MD's information compression technique called ATRAC (Adaptive TRansform Acoustic Coding) and sends it to memory controller 5. The memory controller 5 first writes the input compressed audio data into shockproof memory 6 and then reads the compressed audio data from shockproof memory 6 and sends it to encoder/decoder signal processing circuit 34. Here, markings for modulation and error correction are attached.

[0025] The memory controller 5 of the system-control microcomputer 9 identifies available area for storage on disk 31 from TOC information stored in shockproof memory 6 and the servo circuit 10 of the system-control microcomputer 9 searches the available storage area. Once the search of the available storage area is completed, the system-control /5

microcomputer 9, according to the signal output by encoder/decoder signal processing circuit 34, causes head activator circuit 15 to activate recording head 16. At the same time, driver circuit 11 activates laser circuit of the optical pickup 32, which generates a stronger laser light than reproduction time on the magnetic application section of disk 31, which allows modulated data to be recorded on the disk 31. These optical pickup 32, encoder/decoder signal processing circuit 34, memory controller 5, head activator circuit 15 and recording head 16 are components of the recording device mentioned in the claim section.

[0026] When the storing to the disk 31 is completed, the memory controller 5 of the system-control microcomputer 9 modifies TOC information stored in shockproof memory 6. This newest TOC information is used to manage audio information stored in disk 31. For example, the TOC area on the inner areas of the disk 31 (called U-TOC area) is replaced by the newest TOC information.

[0027] In the above configuration, when audio information is being dubbed from CD to MD, if reproduction error is generated on the CD side or if recording error is generated on the MD side, as the dubbing speed increases to a faster speed than normal, it becomes more possible that the re-write time cannot be absorbed by the shockproof memory 6. Thus, in order to record compressed audio data continuously without breaking up the record at the error location, a retry process is necessary which accesses error locations on CD and MD respectively.

[0028] The issue here is the fact that the recording formats of CD and MD are different. The parameters for each are listed below:

[0029] [CD]

1 frame = 6 sampling data

1 sub-code frame = 98 frame

= 588 sampling data

= 1/75 second

Access unit = each sub-code frame

[MD]

1 sound group = 512 sampling data (compression unit)

1 sector = 5.5 sound group

= 2816 sampling data

1 cluster = 32 sector

= 176 sound group

= 90112 sampling data

Access unit = each sector

Minimum recording unit = cluster unit

As these illustrate, data length of access unit on CD is different from data length of compression unit, data length of access unit or minimum recording unit on MD. This requires, for retry process, a control method to adjust the CD reproduction resumption timing and MD recording resumption timing. To enable this control, as shown in Figure 4 (a) through (c), system-control microcomputer 9 should count each single sound group of audio data (512 sampling data) being read out, and should control the audio data by sound group units.

[0030] During the process of dubbing from CD reproduction system to MD recording & reproduction system, as Fig. 2 (a) and (b) show, as

soon as the reading of audio data from disk 41 (CD) begins, on the MD recording & reproduction system, each sound group of audio data transmitted to voice expansion/compression circuit 7 is compressed to 1/5, and written to shockproof memory 6 sequentially by memory controller 5.

[0031] Additionally, as shown in Figure 2 (c), the recording start position of cluster 1 is being searched on disk 31 until compressed audio data from cluster 1, the first recording unit to be recorded, is completely written to shockproof memory 6.

[0032] Next, as soon as cluster 1 is completely written to shockproof memory 6 and as writing of cluster 2 begins, cluster 1 is read from shockproof memory 6 at a higher rate than write rate and is recorded on disk 31. Therefore, since the read speed from shockproof memory 6 is faster than write speed, compressed audio data is read from shockproof memory intermittently. Because of this, during the time between cluster 1 compressed audio data is read from shockproof memory 6 and cluster 2 is completely written to shockproof memory 6, storage start location of cluster 2 is being searched on disk 31. By the time cluster 2 is completely written to disk 31, part of cluster 3 reproduction is already completed.

[0033] Next, consider a case as shown in Figure 2 (a) and (b), when up to Point A of compressed audio data of cluster 3 was recorded on disk 31, because of an external shock, for example, the optical pickup 32 should be bumped off the track or sound skipping should happen on the CD reproduction device 20. In this case, the error generating minimum recording unit is cluster 3. At this time, system-control microcomputer 9 detects recording error or reproduction error, and temporarily halts

recording action of MD record & reproduction system and reproducing action of CD reproduction device 20, and then starts the retry process.

[0034] At this time, recording up to cluster 2 had been completed normally on disk 31, and compressed audio data of cluster 3 has been written to shockproof memory 6 normally. If the reproduction is resumed after going back part way from the error location where the error had /6 occurred on disk 41, the newly obtained compressed audio data would overlap the compressed audio data already stored in the shockproof memory 6. Therefore, if compressed audio data already stored in shockproof memory 6 is confirmed to match the newly obtained compressed audio data, and if the same compressed audio data is written over on shockproof memory 6, the error can be resolved.

[0035] In this manner if, after cluster 3 is written over in the shockproof memory 6, data from the start of cluster 3 is read and recorded on disk 31 again, and then dubbing of cluster 4 and on is continued normally, compressed audio data can be dubbed on disk 31 continuously without any impact from generated errors.

[0036] The following is a detailed description of verification process which compares new compressed audio data following the resumption of reproduction and compressed audio data already stored in shockproof memory 6.

[0037] Considering compression format of compression LSI that is used by voice expansion/compression circuit 7, disk 41 would resume reproduction starting at a sound group (sound group 25 in Fig. 1 (b) of this example) which is two sound groups prior to the said Point A. However,

since access unit of CD is one sub-code frame, this means that the access is actually made in disk 41 to the start of the sub-code frame which is two sub-code frames prior. Note that, as shown in Fig. 1 (a), access to disk 41 uses synchronizing signal (sub-code frame sync), which is reproduced from the start of each sub-code frame. In this example, system-control microcomputer searches sub-code frame sync 21 and directs CD reproduction device 20 to resume reproduction of disk 41.

[0038] Next, after resuming reproduction of disk 41 based on the relationship between data contained in sub-code frame starting at sub-code frame sync 21 and data contained in sound group 25, the system-control microcomputer 9 identifies and reads compressed audio data from shockproof memory 6 that corresponds to new compressed audio data output from voice expansion/compression circuit 7. And, by verifying new compressed audio data against stored compressed audio data, it identifies, as shown in Fig. 1 (c), the start point of sound group 26, one prior to Point A. After confirming the memory location on shockproof memory 6 this way, as shown in Figure 1 (d), it directs memory controller 5 to resume write process on shockproof memory 6 starting at sound group 27, the compression unit of that generated the error. This would overwrite compressed audio data from sound group 27 through sound group 176 of cluster 3.

[0039] In the mean time, until writing of compressed audio data of cluster 3 to shockproof memory 6 is completed, storage start position of cluster 3 is being searched on disk 31. When cluster 3 is completely written to shockproof memory 6, as shown in Fig. 3, the recording to disk 31 resumes starting at the beginning of cluster 3. In this manner, audio

data on disk 41 is dubbed to disk 31 continuously without any impact from generated errors.

[0040] If speed of data transfer from CD reproduction system to MD recording & reproduction system is high, it is possible that time to re-write to shockproof memory 6 might not be absorbed. In this case, however, CD reproduction and MD recording & reproduction are halted temporarily until re-write to shockproof memory 6 is completed, and recording to MD is resumed subsequently. This way, errors can be resolved reliably regardless of data transfer speed.

[0041] [EFFECT OF THE INVENTION]

As stated above, recording & reproduction device of this invention is composed from: a memory device that temporarily stores the compressed data, which was compressed by a recording system, by units of compression; a recording device that reads out compressed data intermittently from above memory device, where the smallest recording unit is made up from multiple compressed units, and sequentially records minimum recording units in the above second recording media; a halt command device that detects errors from at least either of reproduction errors of first recording media or recording errors of above second recording media, and temporarily stops operation of recording system and reproduction system accordingly; a reproduction control device that detects the access unit where an error has occurred during reproduction, and resumes reproduction by reproduction system starting from several access units before the access unit where the error had originated; a verification device that identifies and reads out from the memory device the compressed data corresponding

to the access unit which resumed reproduction, and verifies this data against the new compressed data created after the resumption of reproduction, and identifies the starting location of the compression unit of the new compressed data; a memory control device that, based on the result of above verification device detection, re-writes new compressed data starting from the beginning of the compression unit where the error had occurred; and a recording control device that reads compressed data from above memory device starting with the beginning of the smallest recording unit where the error had occurred, and that resumes recording on above second recording media of the recording system.

[0042] Therefore, even when errors occur while dubbing from first recording media to second recording media of different recording format, continuous dubbing of audio data to second recording media without any impact from errors by resuming the writing to memory device, after reproducing audio data again, starting from compression unit just /7 prior to error location. Additionally, even when data transfer speed from reproduction system to recording system is very high, errors are resolved reliably by halting reproduction system and recording system temporarily as errors occur.

[Brief description of the figures]

FIGURE 1: Figure 1 is a timing chart that shows retry process of recording/reproduction device related to this invention.

FIGURE 2: Figure 2 is a timing chart that shows relationships among reading of audio data from CD, compressing audio data and placing it to memory on MD recording & reproduction system, and recording compressed

audio data to MD.

FIGURE 3: Figure 3 describes contents of recorded digital data on MD after retry process.

FIGURE 4: Figure 4 (a) and (b) show managing of audio data reproduced from CD in the same data lengths as compression unit on MD. (c) shows data length of minimum recording unit on MD.

FIGURE 5: Figure 2 is a block showing one configuration example of recording and reproduction system related to this invention.

DESCRIPTION OF MARKINGS:

2. Optical pickup (recording device)

4. Encoder/decoder signal processing circuit (recording device)

5. Shockproof memory controller (recording device and memory control device)

6. Shockproof memory (memory device)

9. System-control microcomputer (recording device, halt command device, reproduction control device, verify device, and recording control device)

15. Head activation circuit (recording device)

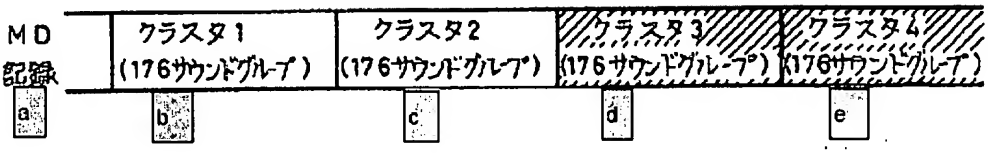
16. Recording head (recording device)

20. CD reproduction device (reproduction system)

31. Disk (second recording media)

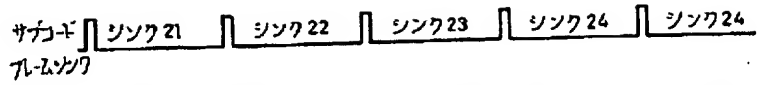
41. Disk (first recording media)

FIGURE 3

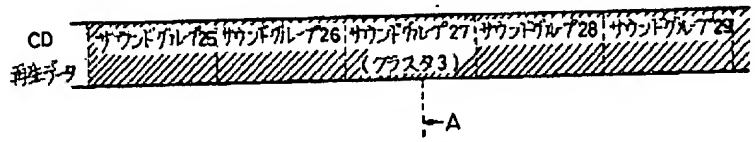


Key: (a) MD record;
(b) Cluster 1 (176 sound groups);
(c) cluster 2 (176 sound groups);
(d) cluster 3 (176 cluster groups);
(e) cluster 4 (176 sound groups).

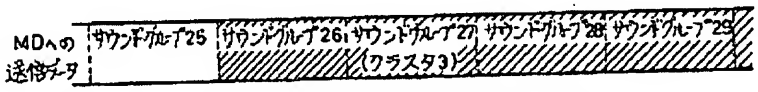
FIGURE 1 /8

(a) 

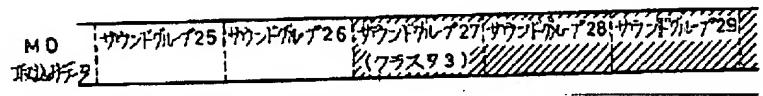
(a) Sub-code frame sync: sync 21, sync 22, sync 23, sync 24, sync 24

(b) 

(b) CD reproduction data: sound group 25, sound group 26, sound group 27, sound group 28, sound group 29; (cluster 3)

(c) 

(c) Transfer data to MD: sound group 25, sound group 26, sound group 27, sound group 28, sound group 29; (cluster 3)

(d) 

(d) Data written on MD: sound group 25, sound group 26, sound group 27, sound group 28, sound group 29; (cluster 3)

FIGURE 2

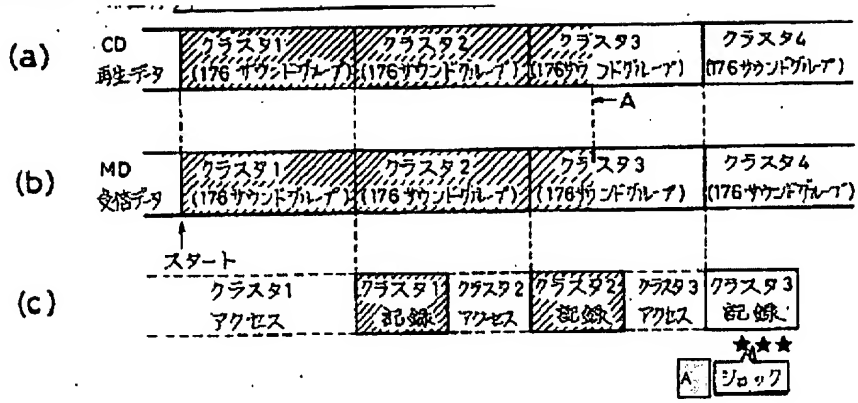


Figure 2 captions:

(a) CD reproduction data: Cluster 1 (176 sound groups), cluster 2 (176 sound groups), cluster 3 (176 cluster groups), cluster 4 (176 sound groups)
(b) MD received data: Cluster 1 (176 sound groups), cluster 2 (176 sound groups), cluster 3 (176 cluster groups), cluster 4 (176 sound groups)
(c) Start; Cluster 1 access, cluster 1 record, cluster 2 access; cluster 2 record, cluster 3 access, cluster 3 record;
(A) shock

FIGURE 4

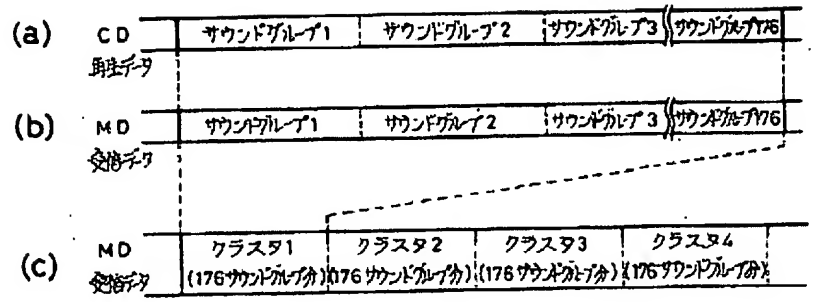


Figure 4 captions:

(a) CD reproduction data: Sound group 1, sound group 2, sound group 3, … sound group 176
(b) MD received data: Sound group 1, sound group 2, sound group 3, … sound group 176
(c) MD received data: Cluster 1 (176 sound groups), cluster 2 (176 sound groups), cluster 3 (176 cluster groups), cluster 4 (176 sound groups)

FIGURE 5 /10

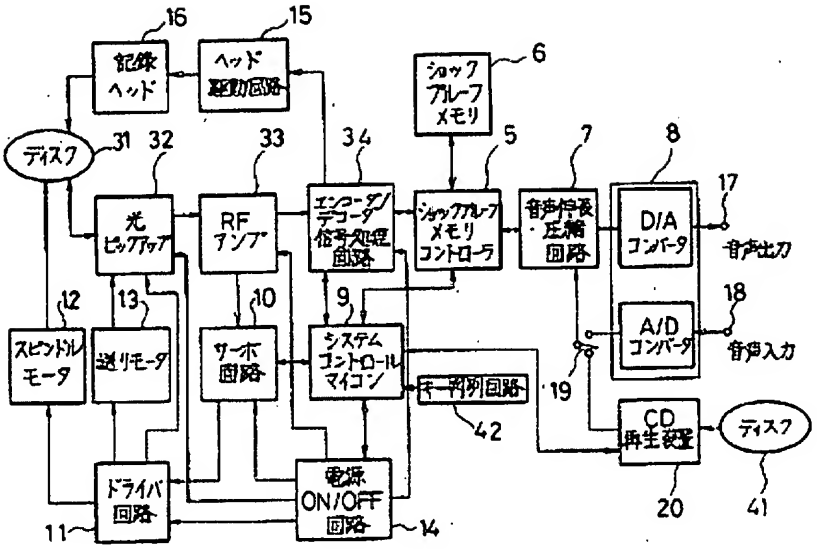


Figure 5 captions:

5. Shockproof memory controller
6. Shockproof memory
7. Voice expansion/compression circuit
8. D/A converter and A/D converter
9. System-control microcomputer
10. Servo circuit
11. Driver circuit
12. Spindle motor
13. Feed motor
14. Power ON/OFF circuit
15. Head activation circuit
16. Recording head
17. Voice output
18. Voice input
19. Switching unit
20. CD reproduction device
31. Disk
32. Optical pickup
33. RF amplifier
34. Encoder/decoder signal process circuit
41. Disk
42. Key identification circuit